



General methodology for the derivation of high resolution oceanic data through information fusion at different scales

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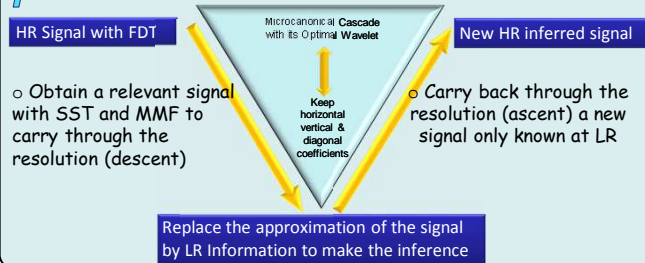
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Abstract

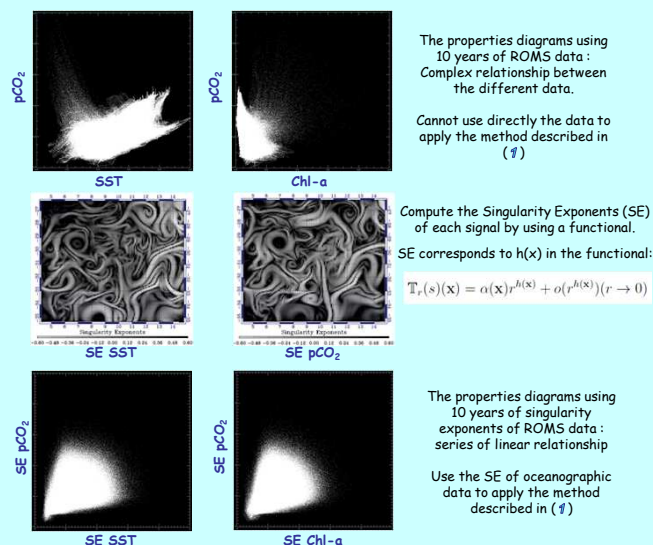
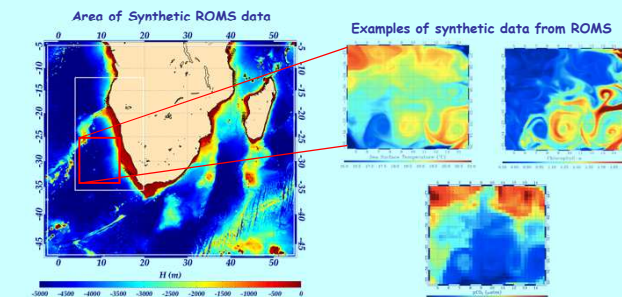
Derivation of high-resolution (HR) spatial distribution of data is a fundamental problem in Earth Observation. The problem can be solved through **information fusion at different scales**.

- New method based on an **approximation of the energy of Microcanonical Cascade (MC)**, expressed in a **Multiscale Microcanonical Formulation (MMF)**, for physical intensive variables of Fully Developed Turbulence (FDT) encountered in satellite Oceanography and Ocean/Climate interactions.
- The **generality of the approach** offers the opportunity to infer different oceanic turbulent signals from Low Resolution (LR) to HR. Basic idea:
 - **optimal cascading** to decrease the spatial resolution of the HR signal,
 - use the signal available at LR, **transmit that information along the scales back** to higher spatial resolution using the cascade to obtain a new HR signal.
- The process has been successfully used to obtain **oceanic currents** [1,2], **oceanic partial pressure of CO₂** [3].
- **Extension to many Essential Climate Variables** both in the ocean and atmosphere critical for characterizing Earth's climate and its changes.

1 General concept of the MMF/MC method



2 Relationship between the different oceanic signals: To use the general concept (1), we need to verify the « linearity » between HR and LR signals.

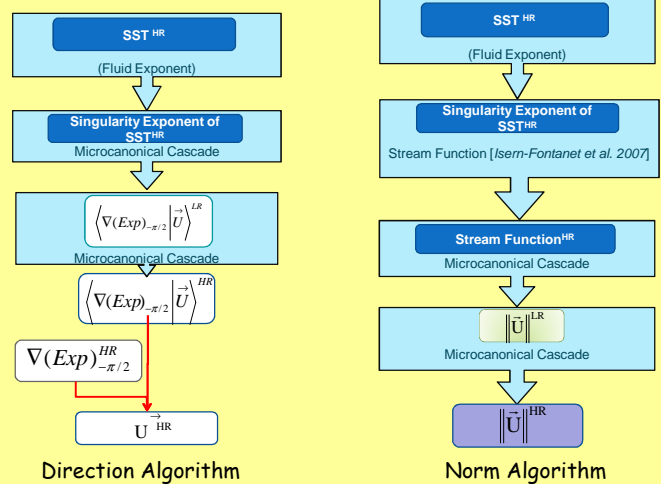


Method to obtain HR pCO₂ using HR SST, HR Chl-a, LR pCO₂

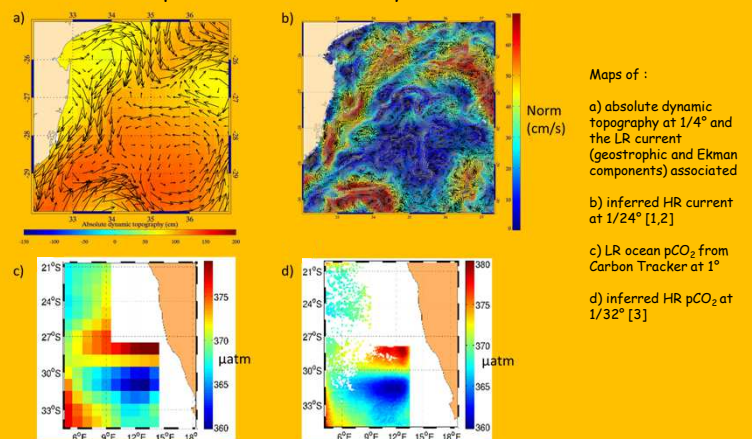
- 1) $A(x) SE_SST_{HR}(x,t) + B(x) SE_Chl_{HR}(x,t) + C(x) SE_pCO_{2LR}(x,t) + D(x) = Proxy[SE_pCO_{2HR}(x,t)]$
A(x), B(x), C(x), D(x): coefficients of the multi-linear regression computed using Roms data
- 2) Apply the general concept to the Proxy[SE_pCO_{2HR}(x,t)]:
For each time t, compute SE of satellite data.
Injection in the multi-linear regression above to obtain the Proxy[SE_pCO_{2HR}(x,t)]
Use the proxy as « HR signal with FDT », and the pCO_{2LR} replace the approximation coefficients in the general concept.

This method is fully described and validated with *in-situ* data in [3].

3 To obtain Oceanic current at HR : Separation of Norm and Direction (See [1,2] for full description and validation with *in-situ* data)



4 Examples of data obtained by the MMF/MC method



Conclusion and Future Work

- **Evidencing multiscale geometric structures in synthetic ROMS data and satellite data data through the Multiscale Microcanonical Formalism**
- **Validation of algorithms on synthetic ROMS data**
- **Application of the algorithms on satellite data**
- **Validation of the new HR satellite data with *in-situ* data**

➤ **Future Work:** Application of this general method for Altimetry (SWOT project submitted on OST-ST/TOSCA)

References

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